UEAA NEWSLETTER

2024, No. 4

Nitra, September 24, 2024

LATEST NEWS

Satellite data for precision agriculture: from research to the field

Simone Orlandini[1], Michele Pisante[2], Marco Vieri[1]

1 - Accademia dei Georgofili, Università degli Studi di Firenze

2 - Accademia dei Georgofili, Università degli Studi di Teramo

Satellite data is transforming precision agriculture by giving farmers detailed insights into their crops, enabling more informed decision-making. Once confined to research, this technology is now becoming increasingly accessible for practical use in the field. However, to ensure that the data truly benefits agriculture—characterized by diverse pedoclimatic, technical and crop conditions—several challenges must be addressed. Facilitating effective dialogue between data users and providers is essential for the successful adoption of these innovative techniques. This transfer of technology is vital for maximizing the impact of satellite data on precision agriculture, helping farmers to fully leverage these tools to boost productivity, reduce costs, and minimize environmental impacts.

Modern agriculture harnesses the synergies between remote sensing, mechanization, and advanced engineering, utilizing updated interoperable digital data to support site-specific decisions for sustainable agronomic management. Satellite data is crucial for monitoring, estimating, and verifying the impacts of agronomic practices on indicators such as water erosion and soil organic carbon content. Additionally, current satellite data facilitates the creation of digital soil maps through multi-temporal remote sensing analysis, providing a viable alternative to traditional geospatial mapping methods and optimizing the identification of sampling points, significantly reducing time and costs.

As the use of satellite data grows, there is a need for greater disciplinary knowledge to validate early detections of biotic and abiotic stresses, driven by climate change, across different spatial and spectral scales. This is essential for timely interventions to mitigate the spread of vulnerabilities in specific cropping systems.

Precision Agriculture's smart technologies represent a complex and often chaotic landscape, necessitating interconnected enabling technologies. Digital language acts as the critical link between these technologies, the measured objects and spaces, analysis and decision-making processes, and human operators, who remain central to making informed decisions and executing precise actions through automation and robotics. This deeper understanding of variability allows for the anticipation of uncertainties and the evaluation of the production process's quality and sustainability.

Space technologies are prime examples of scalable tools that can be effectively utilized across various farm sizes. However, this requires a shift in entrepreneurial thinking, moving from a generalized crop cultivation model to one that is variable and tailored, supported by multidimensional analysis systems. Innovating the agricultural business model involves strategic actions to introduce and adopt new technologies, including: 1) a clear understanding of the innovation's value proposition, 2) the selection of appropriate and reliable technologies, 3) updating business structures, infrastructures, and human capital through training, and 4) ensuring the necessary territorial innovation system is in place to support these technologies. The foundation of this evolution lies in educating and training human capital, equipping them with the knowledge and skills needed to master this new production paradigm.

A recent example of the development of these technologies, is represent by IRIDE project. Currently under development, IRIDE is an Earth observation satellite constellation initiated by the Italian government, supported by resources from the National Recovery and Resilience Plan (PNRR). IRIDE is set to be completed by 2026 under the management of the European Space Agency (ESA), with support from the Italian Space Agency (ASI). Designed as a "constellation of constellations," IRIDE consists of several sub-constellations of satellites positioned in low Earth orbit (LEO), known as the Upstream Segment, along with the ground operational infrastructure (Downstream) and services intended for the Italian Public Administration (Service Segment). Specifically, IRIDE involves the development, launch, and service provision of satellites equipped with various sensing technologies, such as Synthetic Aperture Radar (SAR) sensors, high and medium resolution optical sensors, or sensors operating in different frequency ranges, including panchromatic, multispectral, hyperspectral, and infrared bands. In addition to providing services to the Public Administration, IRIDE aims to support Civil Protection and other agencies in combating hydrogeological instability and wildfires, protecting coastlines, monitoring critical infrastructure, air quality, and weather conditions. Moreover, IRIDE will provide analytical data for the development of commercial applications by startups, small and medium-sized enterprises, and industry sectors.

Taking into considerations the current progress of the technologies and the conditions of agriculture, the following points can be considered as the basis for a concrete application of satellite information in agriculture:

- The need to deepen agronomic and bio-physical knowledge of agricultural system components
- Develop joint approaches for the development of technologies tailored to the needs of agriculture
- Implement training and professional development programs for technicians